3.10 Paleontology

3.10.1 Regulatory Setting

Paleontology is a natural science focused on the study of ancient animal and plant life as it is preserved in the geologic record as fossils.

A number of federal statutes specifically address paleontological resources, their treatment, and funding for mitigation as a part of federally authorized projects.

16 United States Code (USC) 461-467 (the National Registry of Natural Landmarks) establishes the National Natural Landmarks (NNL) program. Under this program property owners agree to protect biological and geological resources such as paleontological features. Federal agencies and their agents must consider the existence and location of designated NNLs, and of areas found to meet the criteria for national significance, in assessing the effects of their activities on the environment under NEPA.

23 United States Code (USC) 1.9(a) requires that the use of federal-aid funds must be in conformity with federal and state law.

23 United States Code (USC) 305 authorizes the appropriation and use of federal highway funds for paleontological salvage as necessary by the highway department of any state, in compliance with 16 USC 431-433 above and state law.

Under California law, paleontological resources are protected by the California Environmental Quality Act (CEQA).

3.10.2 Affected Environment

This section is based on the following reports for the Proposed Project:

- *Paleontological Resources Evaluation Report* (PER) (January 2014)
- *Supplemental Paleontological Resources Identification and Evaluation Report* (Supplemental PIR/PER) (August 2015)

The Supplemental PIR/PER was prepared to address project modifications that incorporated areas that were not evaluated in the original PER.

The area studied for this Project is the Area of Project Disturbance (APD) for all areas of the SR-241/SR-91 Express Lanes Connector Project where excavation is proposed. The locality search extended over 1 mile (mi) from the boundary of the

APD to assist with determining the paleontological sensitivities of geologic formations in the area. The APD is based on the horizontal and vertical extent of anticipated project-related ground-disturbing activities. A "Research Area" boundary of up to 1 mi on either side of the APD was used as a study area.

The APD is at the northern end of the Peninsular Ranges Geomorphic Province (province) of southern California. This province is characterized by a series of mountain ranges separated by northwest-trending valleys subparallel to faults branching from the San Andreas Fault. The trend of topography is similar to that of the Coast Ranges Geomorphic Province to the north, but the geology is more like that of the Sierra Nevada, with granitic rock intruding on older metamorphic rocks. The geology of the APD contains extensive pre-Cretaceous (more than 145 million years ago) igneous and metamorphic rocks covered by limited exposures of post-Cretaceous (less than 66 million years ago) sedimentary deposits.

An approximately 5-acre acquisition area on the south side of SR-91, roughly between Coal Canyon and Gypsum Canyon lies with the Irvine Ranch NNL. Irvine Ranch NNL is an area of national significance because it is an outstanding example of major biological and geological features. Fossils of hadrosaurian (duckbilled) dinosaurs have been discovered within the Irvine Ranch NNL, although not within the formations exposed in the 5-acre acquisition area.[1,2,3,4]

3.10.2.1 Locality Search

A locality search, including the APD and 1 mi from the boundary of the APD was conducted through local museums, and included a literature review and a records search. The purpose of the locality search was to determine which geologic sediments within and adjacent to the APD would likely be exposed during ground-disturbing activities associated with proposed improvements and to establish the status and

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1 Irvine Ranch Conservancy. Website: http://letsgooutside.org/about/as-rare-as-a-rainforest/ (accessed May 11, 2016).

2 Morton, Douglas M. 2004. Preliminary Digital Geologic Map of the Santa Ana 30' x 60' Quadrangle, Southern California. Version 2.0. Digital preparation by Rachel M. Alvarez and Kelly R. Bovard. United States Geological Survey Open-File Report 99-0172. Map Scale 1:100,000.

3 Hilton, Richard P. 2003. *Dinosaurs and Other Mesozoic Reptiles of California*. University of California Press. 318 pp.

4 Morris, William J. 1973. *A Review of Pacific Coast Hadrosaurs.* Journal of Vertebrate Paleontology 47(3):551-561.

extent of previously recorded paleontological resources within and adjacent to the APD.

Literature Review

The literature review included a review of area geology, any fossil resources recovered within sediments similar to those that have the potential to be encountered during excavation associated with the Proposed Project, and the paleontological sensitivity of the sediments exposed in the APD based on fossil finds from similar sediments in southern California. The results of the literature review indicated that where excavation may occur within the APD, there are nine geologic units exposed on the surface, and therefore have the potential to be encountered during construction of the proposed improvements. Two geologic units exposed on the surface within the APD, Artificial Fill and Holocene Landslide Deposits, do not have the potential to contain paleontological resources. Holocene Landslide Deposits do not have the potential to contain paleontological resources because of their young age (less than 11,700 years). Artificial Fill does not have the potential to contain scientifically valuable paleontological resources because it has been disturbed. Any fossil remains encountered in Artificial Fill would lack their original geologic context. Both of these geologic units may be on top of units that do have the potential to contain paleontological resources. Two other geologic units exposed on the surface within the APD, Holocene and late Pleistocene Young Alluvial Fan Deposits and Young Axial Channel Deposits, have a low paleontological sensitivity and do not have the potential to contain paleontological resources at depths shallower than approximately 10 feet (ft) below the surface. However, at depths greater than 10 ft, the sediments within these geologic units likely date to the late Pleistocene and are old enough to have the potential to contain paleontological resources. Therefore, sediments below a depth of 10 ft within these geologic units have a high paleontological sensitivity.

Five geologic units exposed on the surface within the APD, the Schulz Ranch Member of the Williams Formations, the Santiago Formation, the Undifferentiated Sespe/Vaqueros Formation, the Topanga Formation, and the Very Old Alluvial Fan Deposits, have a high paleontological sensitivity and potentially contain paleontological remains. The Silverado Formation and the Baker Canyon Member of the Ladd Formation also occur within the APD and have a high paleontological sensitivity; however, excavation into these two formations is not expected. Within the approximately 5-acre parcel in the NNL where ground disturbance will occur, four geologic units are present: the Santiago Formation, Very Old Alluvial Fan Deposits, Young Alluvial Fan Deposits, and Holocene Landslide Deposits. Each of these units

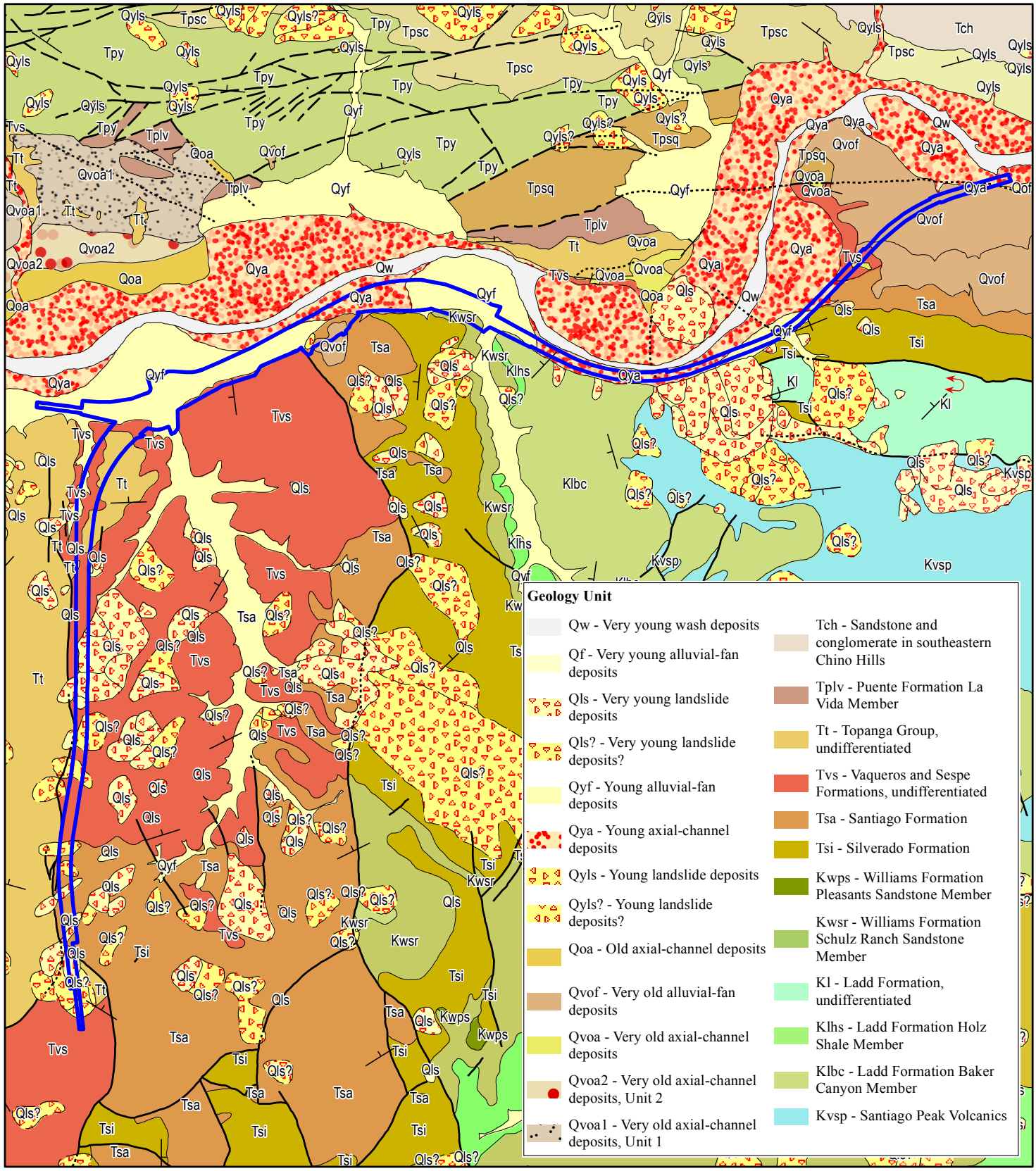
and the locations where they will be encountered are depicted on Figure 3.10.1, summarized in Table 3.10.1, and briefly described below. Each of the underlying geologic units within the APD and the associated paleontological sensitivities of those geologic units are presented as sensitivity polygons on Figure 3.10.2. Figure 3.10.3 shows the geologic units that occur within the NNL in the APD.

Table 3.10.1 Geologic Time Periods and Geologic Units in the Area of Project Disturbance

Epoch	Age (years ago)	Geologic Formation/Unit	Map Symbol
Quaternary Period			
Holocene	Less than 100	Artificial Fill (not mapped, but known to be present)	Af
Holocene	Less than 5,000	Landslide Deposits	Qls
Late Pleistocene to Holocene	126,000 to recent	Young Axial Channel Deposits	Qyf
Late Pleistocene to Holocene	126,000 to recent	Young Alluvial Fan Deposits	Qya
Early to middle Pleistocene	2.54 Ma to 300,000	Very Old Alluvial Fan Deposits	Qvof
Tertiary Period			
Middle Miocene	18–12 Ma	Topanga Formation	Tt
Early Miocene to Late Eocene	40–22 Ma	Undifferentiated Sespe Vaqueros Formation	Tvs
Middle Eocene	50–42 Ma	Santiago Formation	Tsa
Paleocene	56.0-66.0 Ma	Silverado Formation	Tsi
Mesozoic Era			
Late Cretaceous	83–77 Ma	Williams Formation – Schulz Ranch Member	Kwsr
Late Cretaceous	83-77 Ma	Ladd Formation – Baker Canyon Member	Klbc

Source*: Paleontological Resources Evaluation Repor*t (January 2014);
Supplemental Paleontological Resources Identification and Evaluation Report (August 2015).
Note: Refer to Figure 3.10.1 for the locations of these geologic formations and units in the APD.
APD = Area of Project Disturbance
Ma = Million years

The specific sensitivities for the underlying geologic units within the APD, according to the Paleontological Potential Sensitivity Scale used by Caltrans, are listed in Table 3.10.2.



LEGEND

Area of Potential Disturbance

Fault (dashed where approximate and dotted where buried)

Contact

Strike and Dip

N

0 1500 3000

FEET

SOURCE:Morton (2004)

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FIGURE 3.10.1

SR-241/SR-91 Express Lanes Connector

Geologic Map of the Project Area and Vicinity

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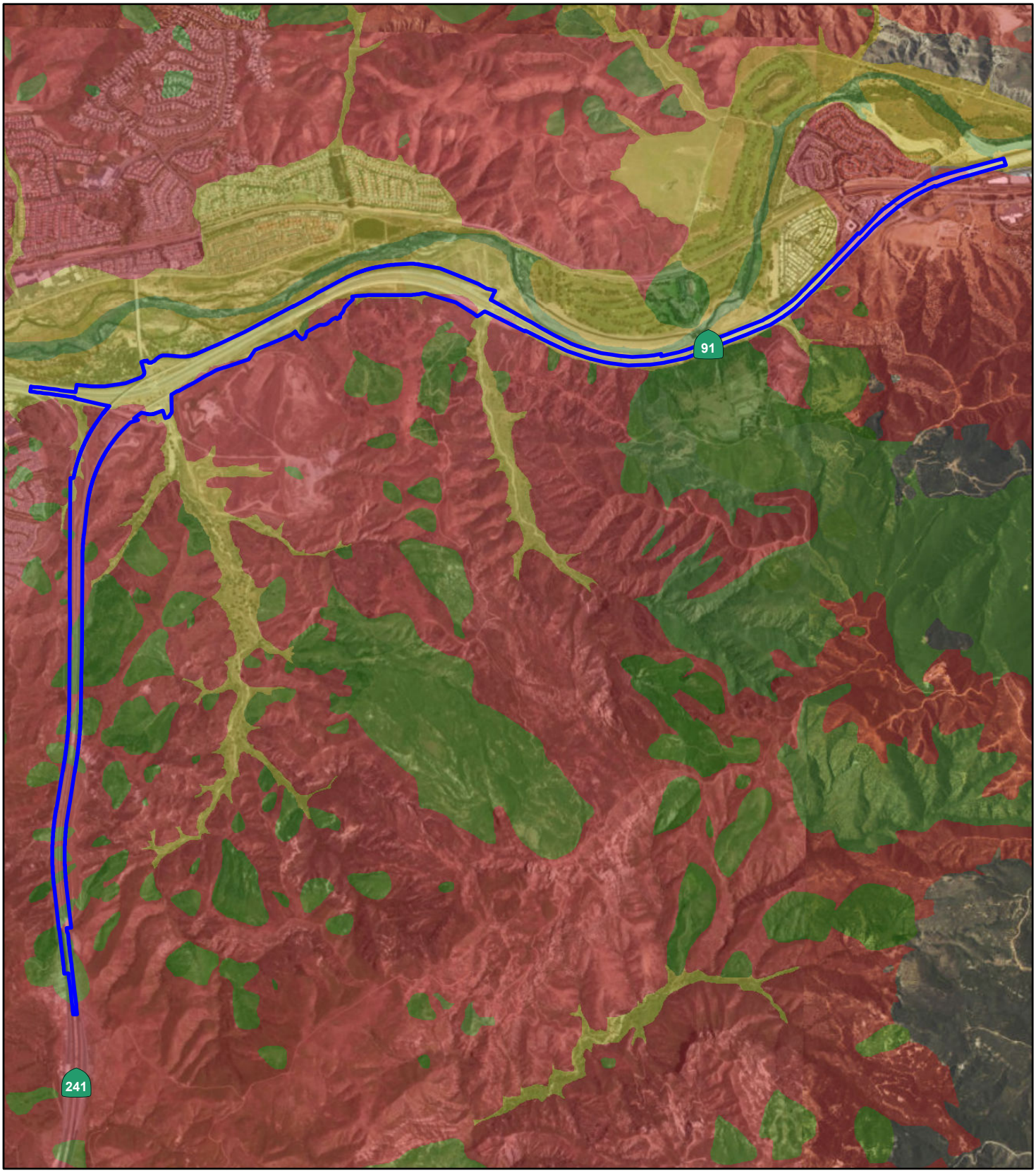

LEGEND

Area of Potential Disturbance

Paleontological Resources Sensitivity

Low

Low 0-10', High below 10'

High

N

0 1500 3000

FEET

SOURCE: Bing Maps (2014); Morton (2004)

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FIGURE 3.10.2

SR-241/SR-91 Express Lanes Connector

Paleontological Resources Sensitivity Map

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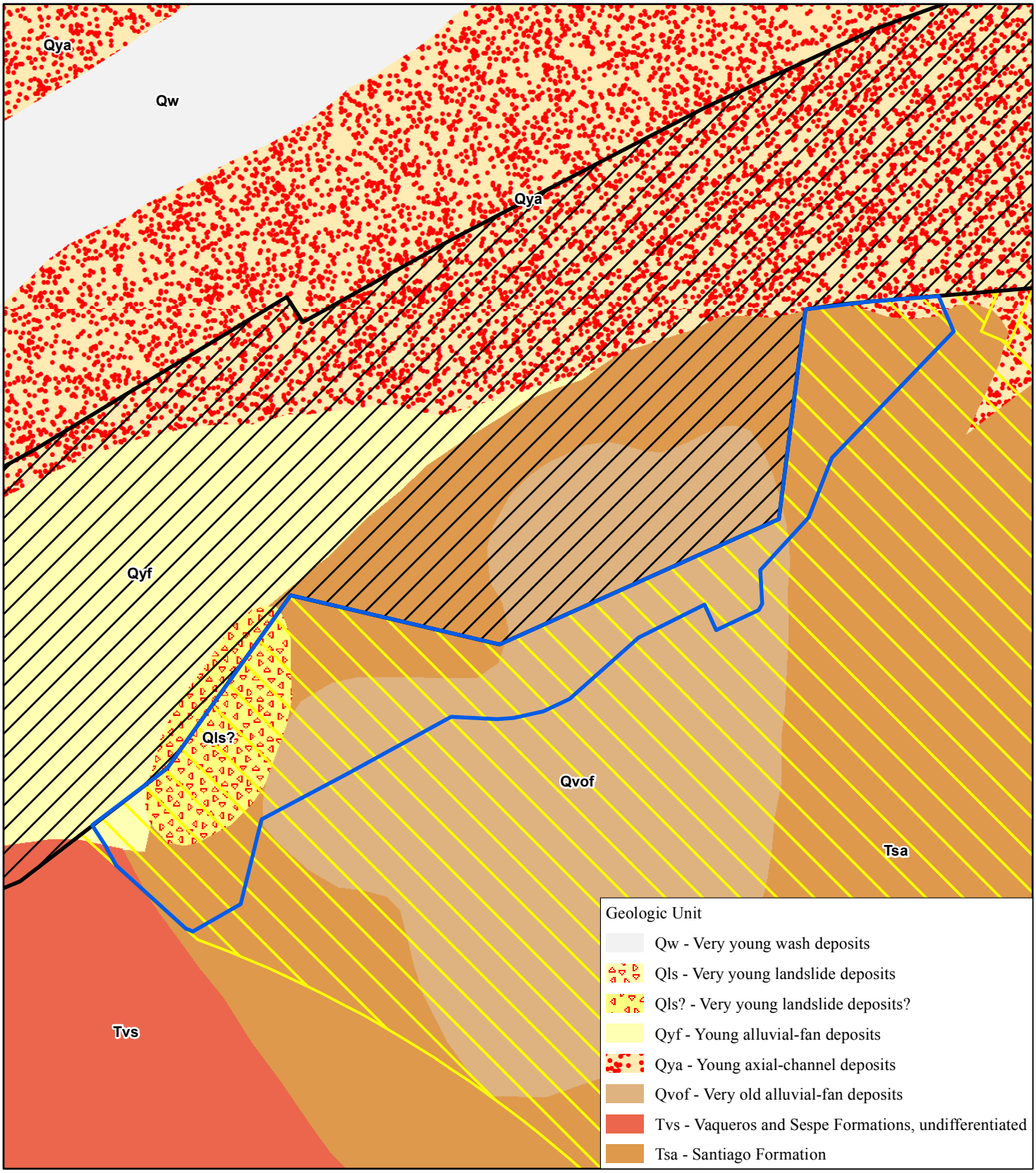

FIGURE 3.10.3

LEGEND

Project Location Studied in 2014 PIR/PER

New Project Area Studied in Current (2015) Supplemental PIR/PER

Irvine Ranch National Natural Landmark (NNL)

N

0 100 200

FEET

SOURCE: USGS 7.5' Quad - Black Star Canyon (1988), CA

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SR-241/SR-91 Express Lanes Connector

Geology Map

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Table 3.10.2 Geologic Units and Paleontological Sensitivity[1] in the Area of Project Disturbance

Geologic Unit	Paleontological Sensitivity[2]
Artificial Fill	No
Holocene Landslide Deposits	Low
Young Axial Channel Deposits	Low 0 to 10 feet High below 10 feet
Young Alluvial Fan Deposits	Low 0 to 10 feet High below 10 feet
Very Old Alluvial Fan Deposits	High
Topanga Formation	High
Undifferentiated Sespe/Vaqueros Formation	High
Santiago Formation	High
Silverado Formation	High
Williams Formation – Schulz Ranch Member	High
Ladd Formation – Baker Canyon Member	High

Source: *Paleontological Resources Identification and Evaluation Report* (January 2014); *Supplemental Paleontological Resources Identification and Evaluation Report* (August 2015).
Note: Refer to Figure 3.10.2 for the locations of these geologic units and the sensitivity of those units in the Area of Project Disturbance.
[1] Also known as Paleontological Potential.
[2] Based on the Caltrans Paleontological Potential Sensitivity Scale.

Locality and Literature Search

A locality and literature search was completed through the Natural History Museum of Los Angeles County (LACM), the San Bernardino County Museum (SBCM), and consultant-maintained records of paleontological resources found within and adjacent to the APD in February 2007, during the Project Scoping process. The locality and literature search included the current APD along SR-241, as well as areas along the *91 Express Lanes* between SR-241 and State Route 71 (SR-71).

Natural History Museum of Los Angeles County

The results of the locality and literature search through the LACM indicated one vertebrate paleontological find within the APD and indicated other finds have been recovered nearby from geologic units that outcrop within the APD. The LACM concluded that all geologic units that the APD crosses, except the younger Quaternary Alluvium (i.e., Artificial Fill, Holocene Landslide Deposits, and the sediments within the Young Alluvial Fan Deposits and Young Axial Channel Deposits that are shallower than 10 ft), have the potential to contain significant paleontological remains.

San Bernardino County Museum

The results of the locality and literature search through the SBCM did not indicate any recorded localities within the APD. However, the SBCM has records of several localities, some within 0.5 mi of the APD, from geologic units mapped within the APD and that could potentially be encountered during project-related ground-disturbing activities. These include a locality in the Santiago Formation that contained gastropods and several localities from within Pleistocene alluvium in the nearby Chino Hills that contained Pleistocene vertebrates. The SBCM concluded that the following formations have a high paleontological sensitivity and may be encountered during project-related ground-disturbing activities: Ladd Formation, Silverado Formation, Santiago Formation, Sespe and Vaqueros Formations, Topanga Formation, Puente Formation, and the older alluvium of Pleistocene age (i.e., sediments within the Young Alluvial Fan Deposits and Young Axial Channel Deposits below a depth of 10 ft and the Very Old Alluvial Fan Deposits). Further study and refinement of the APD indicated that the Puente Formation is not likely to be encountered so it is not addressed further.

3.10.2.2 Field Survey

A field survey was not conducted within or adjacent to the majority of the APD because much of the APD is along existing freeways, with little to no access to exposed sediment. However, two paleontological field surveys/studies have been previously completed in the vicinity of the APD, and a survey was completed for the approximately 5-acre area within the Irvine Ranch portion of the APD. During grading for the SR-241, Paleo Environmental Associates, Inc. provided paleontological mitigation monitoring and collected numerous fossils, including some located within the current APD. During preparation of the initial paleontological assessment of the *SR-91 Eastbound Lane Addition Project* (between SR-241 and SR-71), a field survey of a majority of the APD was completed. That field survey included walking and examining the exposed sediments in the areas of proposed earthwork. The purpose of this initial field survey was to confirm the geology as it was mapped, identify where potential cuts would occur, and determine whether any fossils were exposed on the surface in those areas. During this initial survey, no fossils were observed within any of the geologic units that outcrop along SR-91, and most of the mapped geology was confirmed where it was exposed.

During the preparation of the Supplemental PIR/PER, a pedestrian survey of the approximately 5-acre area that is within the NNL was conducted on March 17, 2015. That area had not been previously surveyed during prior studies. The survey was

completed by walking parallel transects spaced by approximately 10 meters in the flatter areas, as well as by examining outcrops from a distance where the terrain was too steep. The purpose of this survey was to confirm the geology as it is mapped and determine whether any fossils were exposed on the surface. During the survey, the geology was essentially confirmed to be as mapped. Because of a thick growth of weeds and brush, ground visibility was around 30 percent or less. The presence of the Santiago Formation, the Very Old Alluvial Fan Deposits, and the Young Alluvial Fan Deposits could be confirmed as being present; however, due to poor visibility, the Holocene Landslide Deposits could not definitively be verified. No paleontological resources were observed during this survey.

3.10.2.3 Irvine Ranch National Natural Landmark

No special paleontological situation would be anticipated in the APD within the Irvine Ranch NNL. The Irvine Ranch NNL encompasses nearly 40,000 acres, and the geologic units that will be encountered in the portion of the NNL in the APD are all present in other portions of the NNL, as well as other parts of Southern California. There are no known unique paleontological resources from the geologic units in the portion of the NNL in the APD that helped to contribute to the NNL listing.

3.10.3 Environmental Consequences

3.10.3.1 Temporary Impacts

No Build Alternative and Build Alternative (Two-Lane Express Lanes Connector) (Preferred Alternative)

Any impacts to paleontological resources would be considered permanent; therefore, an analysis of temporary impacts to paleontological resources is not applicable to either alternative.

3.10.3.2 Permanent Impacts

Build Alternative (Two-Lane Express Lanes Connector) (Preferred Alternative)

The Proposed Project is anticipated to disturb geologic units in the APD which have high potential to contain significant, nonrenewable paleontological resources. The literature review indicated known fossil localities in geologic units similar to those within the APD, and some fossil localities in proximity to the APD. Research also documented that parts of the APD are in areas identified as having high paleontological sensitivity at the surface and at depth. The locality and literature search indicated that one LACM fossil locality is known to be within the APD and one SBCM locality is known to be within 0.5 mi of the APD. In addition, both the

LACM and the SBCM indicated localities in other areas with the same geologic units that are present within the APD.

As discussed earlier, no special paleontological situation would be anticipated in the portion of the Irvine Ranch NNL that is within the APD. The geologic units that will be encountered in the portion of the NNL within the APD are all present in other portions of the NNL, as well as other parts of Southern California. There are no known unique paleontological resources specific to the geologic units exposed or in the subsurface in the portion of the NNL within the APD that helped to contribute to the NNL listing.

Due to the areas of high paleontological sensitivity in the APD, preparation of a Caltrans Paleontological Mitigation Plan (PMP), as specified below in Measure PAL-1, is required prior to completion of final design.

No Build Alternative

The No Build Alternative does not include any improvements to SR-241 or SR-91 in the APD, and would not result in ground disturbance or excavation. Therefore, no impacts to paleontological resources would occur as a result of the No Build Alternative.

3.10.4 Avoidance, Minimization, and/or Mitigation Measures

The measure listed below is required and will be incorporated during design and construction of the Build Alternative to mitigate permanent impacts to paleontological resources.

Measure PAL-1 **Paleontological Mitigation Plan.** During Final Design a Paleontological Mitigation Plan (PMP) will be prepared and adhered to during construction. The PMP will follow the guidelines of the Society of Vertebrate Paleontologists (SVP) and Caltrans. The PMP will include, but not be limited to:

a. Attendance at the pregrade meeting by a qualified paleontologist or representative;

b. Preconstruction field survey by the paleontological mitigation team;

c. Monitoring during construction excavation by the paleontological mitigation team;

d. Collection of representative samples from geologic formations;

e. Sieving of bulk samples for microfossil recovery;

f. Preparation of specimens to the point of identification and permanent preservation;

g. Curation of fossils into a repository with permanent retrievable storage that meets Caltrans' requirements; and

h. Preparation of a Paleontological Mitigation Report documenting the implementation of the Paleontological Mitigation Plan.

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